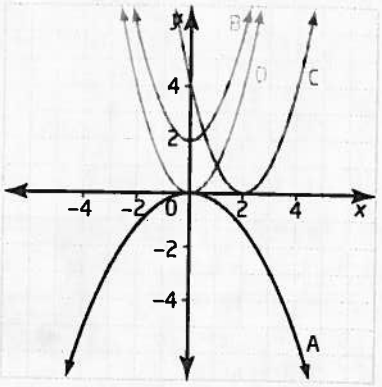
Communicate Your Understanding

C1 How do the graphs of $y = 2x^2$ and $y = -2x^2$ compare? Explain the similarities and the differences.

C2 Match each graph with the appropriate equation. Explain your reasoning.



a) $y = x^2 + 2$

b) $y = -\frac{1}{3}x^2$

c) $y = x^2$

d) $y = (x - 2)^2$

Practise

For help with questions 1 to 4, see the Investigate.

1. Sketch graphs of these three quadratic relations on the same set of axes.

a) $y = -3x^2$ b) $y = \frac{1}{4}x^2$

c) $y = -\frac{1}{4}x^2$

2. Sketch graphs of these three quadratic relations on the same set of axes.

a) $y = (x - 9)^2$ b) $y = (x + 2)^2$

c) $y = (x - 5)^2$

3. Sketch graphs of these three quadratic relations on the same set of axes.

a) $y = x^2 + 8$ b) $y = x^2 - 5$

c) $y = x^2 - 10$

4. Sketch the graph of each parabola. Label at least three points on the parabola. Describe the transformation from the graph of $y = x^2$.

a) $y = 4x^2$ b) $y = \frac{2}{3}x^2$

c) $y = x^2 - 5$ d) $y = (x - 8)^2$

e) $y = -\frac{1}{2}x^2$ f) $y = (x + 3)^2$

g) $y = x^2 + 0.5$ h) $y = -x^2 + 2$

5. a) Make tables of values for $y = x^2$, $y = 2x^2$, $y = x^2 + 1$, and $y = (x - 3)^2$.

b) Compare the y-values for $y = x^2$ and $y = 2x^2$.

c) Compare the y-values for $y = x^2$ and $y = x^2 + 1$.

d) Compare the y-values for $y = x^2$ and $y = (x - 3)^2$.

Connect and Apply

6. Write an equation for the quadratic relation that results from each transformation.

a) The graph of $y = x^2$ is translated 6 units upward.

b) The graph of $y = x^2$ is translated 4 units downward.

7. Write an equation for the quadratic relation that results from each transformation.

a) The graph of $y = x^2$ is translated 7 units to the left.

b) The graph of $y = x^2$ is translated 5 units to the right.

c) The graph of $y = x^2$ is translated 8 units to the left.

d) The graph of $y = x^2$ is translated 3 units to the right.

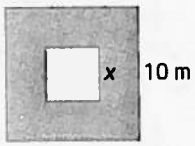
8. Write an equation for the quadratic relation that results from each transformation.

a) The graph of $y = x^2$ is stretched vertically by a factor of 8.

b) The graph of $y = x^2$ is compressed vertically by a factor of $\frac{1}{5}$.

For help with question 9, see the Example.

9. The grass in the backyard of a house is a square with side length 10 m. A square patio is placed in the centre. If the side length, in metres, of the patio is x, then the area of grass remaining is given by the relation $A = -x^2 + 100$.



a) Graph the relation.

b) Find the intercepts. What do they represent?

c) How does the equation change if the grass in the backyard of a house is a square with side length 12 m?

d) For what values of x is each equation valid?

10. The relation $l = 0.04s^2$ can be used to calculate the length, l, in metres, of the skid mark for a car travelling at a speed, s, in kilometres per hour, on dry pavement before braking.

a) What is the length of the skid mark for a car travelling at 50 km/h? 100 km/h?

b) How do the results in part a) compare?

c) For what values of s is this model valid?

d) How would the skid marks and the equation change if the pavement were wet?

Did You Know?

A Technical Collision Investigator or Reconstructionist is a specially trained police officer who investigates serious traffic accidents. These officers collect and interpret evidence to determine the cause of the collision and if any charges should be laid.

11. The first three diagrams in a pattern are shown. Each square has a side length of 1 unit.

a) Make a table comparing base length and area. Use finite differences to determine whether the relation is linear, quadratic, or neither.

b) Determine an equation for the relationship between the base length and the area.

c) Describe the transformation from the graph of $y = x^2$.

Extend

12. The transformations to graph $y = ax^2$ and $y = x^2 + k$ both follow what is indicated by the operation, but in $y = (x - h)^2$, the transformation is opposite to what the operation seems to indicate.

a) Explain why this might be so.

b) Describe the transformation you would use to graph $y = (2x)^2$.

13. A parabola $y = ax^2 + k$ passes through the points $(-1, 3)$ and $(3, -13)$. Find the values of a and k.

14. Compare the graphs of $y = (x - 2)^2$ and $y = (2 - x)^2$. Explain any similarities and differences.

15. Math Contest

a) Identify the similarities and differences in the graphs of $y = (x - 2)^2 + 5$ and $x = (y - 2)^2 + 5$.

b) Solve the second equation for y.